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Dear Dr. Shum Lee, Examiner and Mr. David Porta, Supervisor:
Attached is the simultaneous optical & electronic fusion (as same as my previous drawing and description in nature). If you can find any patent as same as my application, I will withdraw my application, otherwise my application should be granted. It is already 4 years!
E Van.

The real time visible and/or near infrared (VIS/NIR) and middle and/or long infrared (MIR/LIR) fusion system is shown in Fig. 3B. The thin film coated beam splitter 1 will pass almost 100% of the VIS/NIR radiation in 0.38 to 1.1 μ and reflect almost 100% of the MIR/LIR radiation in 3 – 12 μ (MIR: 3 – 5 μ and LIR: 8 – 12 μ) from the same target. Two independent objective lenses L_1 and L_2 can have the same field of view (FOV) or different FOVs. The MIR/LIR can have a large FOV for target searching and the VIS/NIR can have a narrow FOV for target tracking and identification. They also can have the same FOV to do pixel by pixel dual-band fusion. Both sensors can have dual FOVs to match each other.

However, even the VIS/NIR and MIR/LIR have the same FOV because they have different pixel sizes, pixel numbers, and focal plane array formats two images still cannot do pixel by pixel overlay. We must use a formatting circuit to interpolate pixels and scale images to let two images exactly have the same size then we can send them to the image fusion board for fusion. The fusion board must have the capability to move one image up and down or left and right to overlay it on the other image in real time because the beam splitter and other factors will cause image shift although the common optical aperture and axis can remove the parallax between 2 sensors so the most difficult operation – real time image rotation is not necessary to perform. It can be seen from our design that it doesn't matter the target is close or far we always can do real time digital pixel by pixel (same FOV) or picture in picture (different FOVs) image fusion. As shown in Fig. 3B, we also can do simultaneous optical and digital fusion; its working principle is as follows:

The VIS/NIR radiation passes beam splitter 1 will be focused on image intensifier (I^2) tube by lens L_1 to create green image at peak 0.55 μ, this optical image will be imaged on human eye through lens L_3, beam splitter 2, beam combiner, and lens L_5. The MIR/LIR radiation reflected by beam splitter 1 and mirror 1 will be focused on uncooled or cooled focal plane array (FPA) by lens L_2, and the electronic image will be converted to a visible image on liquid crystal display (LCD 1) or other displays by the IR circuit board. This optical image also will be imaged on human eye through lens L_4, mirror 2, beam combiner, and lens L_5. Real time optical fusion is realized. The beam combiner has special coating to allow almost 100% of 0.55 ± 0.1 μ green light to pass but will reflect almost 100% of other visible lights so both VIS/NIR and MIR/LIR images will not reduce intensity. The green light from the I^2 tube will be near 80% reflected by beam splitter 2 then imaged on CCD through mirror 3 and lens L_6. The electronic image will be sent to the sensor fusion board after using A/D converter and CCD circuit board. Similarly, the electronic image from the UFPA or CFPA also will be sent to the sensor fusion board after using A/D and formatting board. Since the CCD and IR FPA have different pixel sizes and numbers and different formats, it is necessary to use the formatting board to interpolate pixels and scale the image to let the IR image and CCD image have the same size so we are able to do pixel by pixel fusion in real time. Of course we also can do picture in picture fusion. From the above description we can see that we have realized simultaneous optical and electronic dual-band image fusion from the same target in real time. The fused image can either have digital output or analog output through D/A converter. Both digital and analog images can have wireless communication. The optical fusion can keep the I^2 image with high resolution for better observation and the digital fusion can do computer image processing and digital recording. Both fused images are useful. If we use CCD not I^2 tube, the L_1 will directly focus on CCD. Optical fusion is not necessary to use and we will use the digital fusion only.